condition of the community." The Charter proceeds to constitute the Fellows of the Society one body politic and corporate, and empowers a General Meeting of the Fellows, *inter alia*, to "enter into any resolution and make any regulation respecting any of the affairs and concerns of the said body politic and corporate that shall be thought necessary and proper."

It has been urged that it would be difficult to make a distinction between ordinary Fellows of the Chemical Society and qualified practitioners admitted and registered through the agency of that Society. This difficulty lies chiefly in the choice of an appropriate name. "Licensed Fellow" has an awkward sound, and "Licentiate" is, by analogy, a lower title than "Fellow." There seems to be nothing in the Charter to forbid such a distinction, which would be for external use only, and would not differentiate the holders of licenses in respect of eligibility to Council, or any other privilege, from ordinary Fellows of the Society. Indeed it does not appear that it would be *ultra vires* for the Chemical Society to grant certificates of competency as Chemists to those who are not Fellows of the Society.

Leaving, however, the question of what is legally practicable, we must confess that in spite of our sympathy with the proposed organisation, we doubt the expediency of effecting it through the instrumentality of a society which has hitherto occupied itself solely with the extension and diffusion of knowledge.

The first granting of licences would be presumably to those who have already an established position as practical chemists. The task of selection would be invidious, and would involve a responsibility from which the Chemical Society would naturally shrink. Subsequently, we presume, licences would be granted upon an examination, and it would seem to be a wide departure from the functions which the Chemical Society has hitherto performed, for it to constitute itself an examining body, or to undertake the appointment of a Board of Examiners.

If no other plan were practicable we might hesitate to express our dislike to the proposal that the Chemical Society should enter upon this new career. But examining bodies, and bodies that issue certificates to those who pass their examinations, are ready to hand. It should not be difficult to obtain the co-operation of the Universities in this matter; and a Board of Examiners appointed by the Universities of Oxford, Cambridge, and London, without necessarily any restriction that those appointed should have received a University degree, would probably command and deserve confidence better than a Board nominated by a newly-formed Institute, or even by the Chemical Society.

At least such a scheme might serve at the outset; and when through its operation chemistry had begun to be consolidated and recognised as a profession, the proposed Institute of Professional Chemists might be formed, and undertake for the future the selection of its own members.

THE ENDOWMENT OF RESEARCH

Essays on the Endowment of Research. By Various Writers. (London: King and Co., 1876.)

IT is to the untiring exertions of Dr. Appleton in the cause which is here pleaded, that we are indebted for this valuable combination of essays. The eminence and competency of the writers give it an overwhelming force of authority and reason. The list of contributors is as follows:—The Rector of Lincoln College, Oxford, Mr. James Cotton, late Fellow of Queen's College, Dr. Appleton, Fellow of St. John's College, Mr. Sayce, Fellow of Queen's College, Mr. Henry Sorby, F.R.S., President of the Microscopical Society, Mr. Cheyne, Fellow of Balliol, one of the company for the revision of the Bible, Mr. Thiselton Dyer, late of Christ Church, Assistant-Director of the Royal Gardens, Kew, Mr. Nettleship, Fellow of Corpus Christi College. These eight writers treat of various aspects of the Endowment of Research —such as the need for it, the applicability of college revenues to the purpose, the incompatibility of teaching and research—in ten essays. No doubt more remains to be written on the subject, more will have to be said, and what is said will need to be said a great many times before the public—even its more intelligent section—comprehend the importance of research or the necessity for its endowment. The present volume may be taken as a fair statement of some of the most important arguments in the matter, and should furnish the starting point for a determined and unwearying effort *permanently* to affect public opinion in the right direction. Widely as we should wish to see this book read amongst the laymen of science, the Philistines and those who prophesy to them, politicians and professional reformers, it will certainly be found quite as valuable as by any of these, by men of science. Men of science will find in the present volume data and suggestions which should aid them greatly, at this critical moment, to determine what they will urge upon the government, as the fit relationship between the State and scientific research.

The substance of these essays may be summarised in the form of a series of questions and answers, the latter being frequently reiterated, as it were, by one after another of the essayists.

1. What is this "research" which you propose to endow? It is more fully described as "scientific research." It is the "disinterested pursuit of knowledge" (Pattison), the following up of "science for science sake" (Pattison), and "by the introduction of the utilitarian motive its strictly scientific character is destroyed" (Appleton). It is co-extensive with the whole range of human knowledge, and comprises such groups as "historical" science, "mental" science, "linguistic" science, (Sayce, Cheyne, Appleton), equally with molar and molecular physics, astronomy, geology and biology. It has its end and aim in itself, viz., the attainment of truth. We assume that it is necessary for man, necessary for his progress, for his happiness if you please, but inevitable whether for weal or for woe, predestined by the noblest and most commanding passion of his nature—*to know the truth.* To the ignorant or unthinking some truths appear to justify this craving on account of the material gratification which their knowledge enables mankind to obtain, whilst the acquirement of other truths appears to these persons superfluous. A consideration of any one department of knowledge is, however, sufficient to show us "that nature is one, and that no man dare put his finger on any of its secrets and say this is a mere field for ingenious curiosity" (Dyer). The narrower type of utilitarian, with his petty measure of what is and what is not for the happiness of mankind,

has no scope for discussion in this matter; he must bow before the inexorable domination of an impulse planted in the very elements of our being. The importance to the community of mature study and scientific research has been recognised in the past both in our own and other countries; at the present day it is very much less appreciated in England than elsewhere. The immense fields which lie open to us, with their harvest of knowledge waiting for reapers, are to some extent indicated in the essays by Mr. Dyer, "On the Needs of Biology," Mr. Cheyne, "On the Study of the Bible," of Mr. Sayce, "On the Needs of the Historical Sciences." Over and over again it will be necessary to explain, as these essays do, how great and of what kind are the stores of knowledge which students see within their grasp, and how difficult and all-absorbing is the task of reaching them. It is the duty of men of science incessantly to exert themselves in inducing the great public, even though this generation and its successor prove stiff-necked and hardened in heart, to believe their report of the promised land.

2. Granting that "scientific research" is a good thing and to be wished for as the highest development of the life of the community, why should it be endowed? Why should persons be supported by public funds to carry on research? Why not leave every man to follow research for his own delectation, and trust to the attractions which it possesses for its increased cultivation?

Because it cannot be successfully carried on, in the present conditions of society, by men who have to earn their bread in any of the usual avocations. Mr. Sorby, in his "Personal Experience" (Essay No. VI.), with convincing simplicity and candour, tells us how all absorbing is research, how much may be lost by withdrawing the man who is engaged in an investigation, even intermittently, from his pursuit, how necessary is ample time, freedom from anxiety, health of body, "readiness of the mind to take advantage of every circumstance that may occur to press forward the inquiry in the line of truth." Fortunately Mr. Sorby is endowed with a patrimony, and he says, "I never could have done what I have been able to do if it had been necessary for me to attend to any business or profession as a means of support." Men who are capable of or disposed to engage in scientific research are not always thus situated. Unless we are prepared to lose the services which these persons might render—some of them perhaps the very ablest and most productive minds—and to rest our hopes on the chance coincidence of fortune and ability, as for instance in the cases of Lyell, Darwin, and Grote, we must accept a scheme for providing such persons with pecuniary support out of public funds. To a certain extent we already do this, but very inadequately. The posts in the British Museum, the Greenwich Observatory, and a few others here and there, are of the nature of endowments for research. But these are so few in number and so meanly paid that they cannot be regarded as exercising any important influence in attracting men of ability into the career of research. Among Continental nations but especially in the German empire, in proportion to the wealth of the countries in question, very much larger provision is made for the encouragement of research—and with the most perfect success, as tested by results. In Germany, owing to the special view which is taken in that country of a "University," there are 1,250 posts designed for the promotion of research with stipends varying in value from 80*l*. to 600*l*. a year. There is one such post to every 33,000 of the entire population, or to every 1,600 males between the ages of twenty and thirty years. The total cost of the support of these persons and the laboratories, libraries, &c., with which they are connected (leaving out of consideration such special institutions as are the exact counterparts of our British Museum, observatory, &c.) cannot be less than 600,000*l*. annually. An equivalent provision in England would necessitate the creation of 1,000 posts at an annual expense of 800,000*l*., making allowance for the fact that money has at least double the value in Germany which it possesses in England, in relation to the purpose under consideration. It is curious to observe that this sum (800,000*l*.) corresponds very closely with the estimated value of the incomes of the ancient University institutions of Oxford and Cambridge—where, however, the money is not applied to the endowment of research.

3. The reference to Universities and to Oxford and Cambridge brings to mind a suggestion which at first sight appears admirable. "Granted that research must be endowed, there is yet great difficulty in persuading practical men to pay for it in the pure and unalloyed form. It can only be a pleasure to the investigator to communicate to pupils the results which he obtains in his researches, clearly it is his natural function to teach. In fact you have already got what you want in the Fellowships of Oxford and Cambridge, many of the holders of which reside in those Universities and teach—and doubtless spend a large portion of their time in research. Abolish the non-resident Fellowships, remove the immoral condition of celibacy, give two or three Fellowships to the men who stay longest in the place, require them all to teach at a cheap rate (this will be well received by the public) and you may be sure that they will devote all needful energy to original research—is not your demand for the endowment of research liberally met in this way?" Certainly not.

The deadly error embodied in the above bids fair at the present moment to destroy the good hope which we at one time possessed of seeing at Oxford at any rate (it is from Cambridge that the mischief has come) a portion of collegiate endowments applied to the support of research. The chief care of the Oxford men who write in Dr. Appleton's volume is to combat the insidious doctrine that *research* is compatible with *teaching*, in the narrow sense in which teaching is understood in Universities which like Oxford and Cambridge are carried on upon the plan originated by and worthy of the Jesuits (see Pattison, Essay No. 1), viz., that in which competition by examination for prizes forms the pivot of all activity. The watchwords of the German Universities "Lehrfreiheit" and "Lernfreiheit," are (save to a very few) unknown, the idea which they express equally so, in this country.

The suggestion that teaching and research should go hand in hand appears at first sight admirable, because there can be no doubt that in the wider and higher sense of the word "teaching," the investigator is and must be a teacher. In the German Universities it is a small tax upon the professor or holder of a research endowment to give a course of lectures upon the subject with the study of which he is occupied. He is entirely free from the influence of the Jesuit's examination system; that has been long since abolished (where it existed) in German Universities. He is never concerned for one moment with the thought as to what place his hearers may take in an examination—such examination as there is being entirely in his own hands—and having very little importance attached to it. Moreover, he cannot (at any rate in the early part of his career) make anything considerable by the fees of his hearers, and has to look for his promotion and increase of income solely to *success in the occupation which his chair assigns to him, namely, original research.*

The preparation of students for an examination by the results of which they are to gain or fail to gain valuable money-rewards, is a business by itself; and the man appointed to carry on this business, especially when his own income and his promotion depend upon his success in placing his pupils well in the examination, cannot pay much attention to other things. He is in a totally different position from that of the German professor. He is in the position which Mr. Sorby deprecates, viz., that of having an anxious commercial pursuit. But, worse still, as Mr. Pattison and Mr. Nettleship point out in their essays, he deals with knowledge and the results of study in such a way (viz., for examination purposes) that he necessarily is liable to become less fitted than any other man of business to pursue knowledge for its own sake. He and his pupils take up a radically false position with relation to knowledge.

The essays of Mr. Pattison and Mr. Cotton are particularly interesting as showing how the present enormous revenues of the Colleges and Universities of Oxford and Cambridge came to be employed, as they are for the most part, in the cheapening of cramming (as Mr. Sayce does not hesitate to call it) and the reward of success in being crammed, or in the subvention of resident college-lecturers and tutors on the one hand, and non-resident competition prize-men on the other. Originally this was not the case; Fellowships were even founded for the express purpose of relieving their holders from the distraction of teaching, in order that they might devote themselves to study. It was unfortunately at a time when the Church was entering upon a new phase of its history, no longer to be the great representative of learning and science, but something very different, that Leicester and Laud handed over the University to the Colleges and the Colleges to the Church. The Fellowships became so much capital, by means of which, in virtue of their monopoly of education, the Colleges were able to convert themselves into what they have with general approval, but to the detriment of science and letters, become—proprietary schools[1] for the "finishing" of young gentlemen. Under the present system the resident Fellow doubles his income through the division of the monopolised fees, whilst the young gentleman's parents pay half[2] what they would have to pay elsewhere for the same amount of constant supervision, cramming, and "direction."

Whatever portion of the collegiate revenues is retained by the new University Commissioners for the College tutors, or as the Oxford Hebdomadal Council has expressed it, for "education" (as that word is understood at the English Universities) is clearly enough lost to research. This proposition is perhaps the main result of the arguments adduced in the essays of the rector of Lincoln, Dr. Appleton, Mr. Sayce, and Mr. Nettleship.

4. All this being admitted, namely, that it is a matter of urgent importance to provide an extensive series of fairly-remunerated posts to be held by persons constantly engaged in research, unencumbered even by the plausible condition of preparing young men for examination, the practical questions come—which with Englishmen are generally the first questions—namely, Whence is the money to be obtained for this purpose, and how are you to ensure that true "research-men" will get the posts supposing that they are once created?

These are two distinct questions. As to the first the answer is simple. It is only through the direct intervention of the Government that the thing can be done. Government may assign for this purpose a large part of the revenues of Oxford and Cambridge, of City Companies, or of the Irish Church; or the sum required may be met annually by the taxes. The "Essays" have chiefly in view, no doubt, the appropriation of a part of the revenues of Oxford and Cambridge to this purpose. At the same time we must remember that even were some 200,000*l.* a-year detached from those institutions and deliberately and simply assigned to the promotion of research under State control, yet even then only a portion of the national requirements would be met. A larger sum than this is needed to carry out even a moderate scheme. When, however, it is proposed to leave the 200,000*l.* a year under the control of its present administrators with general directions to them to employ it in the encouragement of research, we must contend that there is very strong reason, indeed, for an additional altogether independent and strictly national endowment of research—such as has been hinted at by Lord Derby—and such as is carried out by continental Governments.

The second question as to the means to be adopted in order to avoid jobbery and sinecurism in connection with the proposed series of posts, is not discussed in any way in the volume under review. It is, however, one of the most serious questions, and we shall therefore venture very briefly to furnish an answer which is, as far as we can see, completely satisfactory. In a question like this, of serious practical importance, the most conclusive answer is to be found in an existing solution of similar difficulties in a very closely similar case.

This we possess in the great German University system. Whatever objections Englishmen may have to German Universities as teaching bodies, the fact remains that as an arrangement for the endowment of research on a truly national scale they are the most unqualified success. Research *is* endowed by this system and *is* abundantly carried on, and this without (to the writer's knowledge) a suggestion or imputation of jobbery or sinecurism in connection with it.

The elements of this success in the German system are the following:—1. The appointments are held by twenty-one groups of men engaged in research. 2. By custom and the conditions of society (legislative prohibition would have to be called into use in England) these corporations are not allowed to make money by engaging in commercial pursuits or the keeping of boarding-schools. (3) The appointments are graduated in value from 80*l.* to 400*l.* per annum. (4) New members are chosen in any one corporation by co-optation. The promotion of existing members is effected by the same process—one corporation often inviting a member of another to leave his old associates in order to enjoy an increased salary, or increased facilities for research. This co-optation is carefully supervised but not directed by the State Government. (5) Since commercial operations, such as the acquirement of a large revenue by any corporation from the fees of pupils or wards committed to its care, are out of the possibilities of the case—the sole motive which affects the various corporations in their choice of colleagues is a desire to secure colleagues of eminence in the avocation which is assigned to the corporations, namely, research, and in this way to maintain a high reputation for the corporation and congenial association for its members. (6) The result of this is, that the whole stimulus which the prospect of a step-by-step accession of income from 80*l.* to 400*l.* or 600*l.* per annum can bring to bear upon the nature of man is constantly at work in urging those who enter upon this career to give their full energies to research, and research alone. The habit of research so stimulated and fostered, remains even after a career of twenty or twenty-five years—the length of service which entitles the German professor to retire upon full pension.

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[1] See Prof. Max Müller in the *Academy*, May 11.

[2] The Oxford undergraduate pays on an average 20*l.* a year for being prepared for examination. A well-known "grinder" for the Indian Civil Service examinations charges, I believe, 100*l.* a year for similar preparation.

The enormous fertility of Germany in all kinds of research is the outcome of this simple and healthy system. There does not appear to be any reason why a parallel system applied in this country should not produce parallel results.

E. RAY LANKESTER

QUAIN'S ANATOMY

Quain's Elements of Anatomy. Eighth edition, edited by Dr. Sharpey, Dr. Allan Thomson, and Mr. E. A. Schäfer. Two Vols. (Longmans, Green and Co., 1876.)

THE seventh edition of Quain's "Anatomy" appeared nine years ago under the conjoint editorship of Dr. Sharpey, Dr. Thomson, and Dr. Cleland; in the eighth Mr. E. A. Schäfer's name is found on the title page instead of that of the last-named anatomist. The new edition contains much new matter, and with a larger as well as a clearer type, covers nearly an extra hundred and sixty pages.

The arrangement of the subject-matter is considerably modified in the direction of improvement; the descriptive account of the bones, joints, muscles, vessels, and nerves, together with the surgical anatomy, occupying the first volume; the second, containing the general anatomy or histology, the structure of the different viscera, the organs of special sense, and the embryology.

A much-needed advance has been made in the sections devoted to osteology and myology, which consists in the introduction of paragraphs on general morphology. Teachers of anatomy are too apt to entirely neglect those great strides that have been made in zoology, many of which have an important bearing upon the way in which the human skeleton and soft parts should most certainly be regarded. We, upon this view of the question, are therefore glad to find among other innovations, a classified list of the bones of the head, and their typical component parts, the nomenclature adopted being that employed by comparative anatomists.

The introduction of nitrate of silver, osmic and chromic acids, logwood, &c., as adjuncts to histological manipulation, as well as the efforts of many able investigators, have rendered corresponding changes necessary in the sections of the work devoted to the microscopic structure of the tissues and organs; and Mr. Schäfer has here introduced several fresh illustrations, and much new matter, which makes the "general anatomy" by itself an invaluable summary of the most modern aspect of histology. The development of blood corpuscles, the ground-substance of connective tissue, the ultimate nature of muscle, the serous membranes and their lymphatics, have received the greatest additions in this portion of the work.

Dr. Allen Thomson has entirely re-written the chapter on embryology, having embodied all the more recent results in this rapidly advancing department of biological science, arrived at by Foster and Balfour, Parker, Mihalkovics, Waldeyer, and others. The whole forms a most excellent account of human embryology, as far as it can be known from the incomplete direct, and the much indirect evidence which can be brought to bear upon it.

The editors acknowledge the assistance of Dr. Gowers, Assistant-Physician to University College, in the revision of the paragraphs on the Cranial Nerves; and in the chapter on the Brain and Spinal Cord, Dr. Gowers has introduced a valuable account of the cerebral convolutions, together with some excellent drawings, more elaborate than those of Ecker. The nature of the many layers of the cerebral cortex is fully discussed, at the same time that a careful abstract of the terminology of Meynert is given, with additional figures.

There is one minor zoological error which we have not seen corrected in any anatomical or physiological textbooks. It is in the nomenclature of the animals with peculiarly small blood-discs. The "Napu Musk Deer" is said to possess the smallest blood corpuscles of all mammalia. It is now known that the Musk Deer has no special kindredship with the Chevrotains, or Tragulidæ, to which group the Javan Chevrotain (*Tragulus javanicus*), which formerly went by the name of the "Napu Musk Deer," belongs. A reference to Mr. Gulliver's more recent paper[1] also shows that in the Indian Chevrotain (*Tragulus meminna*) the discs are equally minute.

With reference to the typography we think it much improved in all respects, but of the figures we cannot help remarking that sufficient care has not been taken by the printers in doing justice to the artists or the engravers. Several of the older woodcuts are, no doubt, much worn, but they, as well as the more recent ones, are printed much too black, considerably darker than in the previous edition.

OUR BOOK SHELF

Exercises in Electrical and Magnetic Measurement. By R. E. Day, M.A. (London: Longmans, Green, and Co., 1876.)

MR. DAY'S little book on Electrical and Magnetic Measurement seems to us likely to be of considerable

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[1] Proc. Zoolog. Soc., 1875, p. 492.